TE(E) Sem V (old) 01/06/09
Intergrated circuits

Con. 3566-09. VR-6216

(OLD COURSE)

(3 Hours) [Total Marks : 100

Page (1)

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) **Figures** to the **right** indicates **full** marks.
(4) Assume **suitable data** whenever **necessary**.

T.E (E) V old 1/6/09 Intigrated Circuits. 1/6/09.

1. (a) Draw the logic diagram of 7490 counter Ic and explain the counting operation. 10
(b) Explain working of basic Integrator using appropriate waveforms and derivations. Explain disadvantage of basic integrator. Explain how one can overcome these disadvantages. 10

2. (a) List the important features of Ic 555. 4
(b) Draw and explain the functional diagram of a 555 timer. 8
(c) Explain Astable Multivibrator using Ic 555 in detail with waveforms. 8

3. (a) What is voltage transfer characteristics. Draw the voltage transfer characteristics for practical inverter and define V_{OH}, V_{OL}, V_{IL}, V_{IH}. 10
(b) Explain interfacing of TT/CMOS and CMOS/TTL. 10

4. (a) Explain the various features incorporated in Ic 723 voltage regulator in detail. 10
(b) Using 3-Terminal Ic voltage regulator show how a adjustable voltage regulator can be built. 10

5. (a) Design and implement full adder using NAND gate. 10
(b) Design and implement 40:1 MUX using minimum number of 8:1 MUXs. 10

6. (a) Explain Log and Antilog amplifier in detail. 8
(b) Explain R-C Phase shift oscillator using op-amp and derive the expression for frequency of oscillation. 12

7. Write notes on (any **four**) :— 20
(a) SL-440.
(b) Instrumentation Amplifier.
(c) Sample and Hold Circuit.
(d) CA 3059 Block Diagram and operational details.
(e) Switch Mode Power Supply.

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(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Solve any **four** questions out of the remaining **six** questions.
(3) Assume **suitable** data wherever **necessary**.
(4) **Figures** to the **right** indicate **full** marks.

1. Solve any **four** :–
   (a) Explain the relation $\overline{E} = -\nabla V$.
   (b) Derive the Poisson's and Laplace's equation.
   (c) What is uniform plane wave ? Explain its physical significance.
   (d) Explain the concept of scalar and vector magnetic potential.
   (e) Prove that $\nabla \cdot \overline{B} = 0$, where B is magnetic flux density.

2. (a) Using Gauss's law derive $\overline{D}$ in all regions for a uniformly charged sphere having volume charge density ρ_v C/m^3. **12**
   (b) Point charges 1 μC and -1μC are located at $(0, 0, 0{\cdot}5)_m$ and $(0, 0, -0{\cdot}5)_m$ respectively. Using dipole method, calculate electric potential and electric field intensity at a point $P(3, 0, 4)_m$. **8**

3. (a) If $\overline{D} = x^2 yz^2\, a\hat{x} + x^2 yz\, a\hat{y} + xy^2 z^2\, a\hat{z}\ \left(C/m^2\right)$ then calculate the total charge within the cube defined by $0 \le x \le 1$, $0 \le y \le 1$, $0 \le z \le 1$ m. **8**
   (b) Derive the boundary condition for E and D at the interface between two dielectrics. **8**
   (c) State and explain Ampere's circuital law. **4**

4. (a) Two uniform line charge densities $\rho_l = 4n$ C/m lie in X = 0 plane at Y = $\pm$ 4m. Draw the figure in X–Y plane and find electric field intensity due to the two line charges at a point $(4, 0, 10)_m$. **10**
   (b) Using Biot Savart's law, find $\overline{H}$ due to an infinitely long straight conductor. **10**

5. (a) Derive the expression for the Poynting's theorem and explain its significance. **10**
   (b) Give the general set of Maxwell's equations in point form. Derive the set of Maxwell's equations for static fields and harmonically time varying fields. **10**

6. (a) Starting from the Maxwell's equations, prove that – **10**

$$\nabla^2 \overline{E} = \mu \epsilon \frac{\partial^2 \overline{E}}{\partial t^2} + \mu \sigma \frac{\partial \overline{E}}{\partial t}$$

   (b) Derive the expression for voltage and current in terms of sending end voltage and current for a transmission line of length l. **10**

   Hence prove that $Z_0 = \sqrt{Z_{0c}\, Z_{sc}}$

7. Write short notes on any **four** :– **20**
   (a) Method of images
   (b) Uniqueness theorem
   (c) Polarization in magnetic material
   (d) ρ_v and VSWR
   (e) Equation of continuity.

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TE(E) Sem-V(Rev) EMF & waves

Con. 2787-09. VR-5058

(REVISED COURSE)

(3 Hours) [Total Marks : 100

N.B.: (1) Question No. 1 is **compulsory.**
(2) Attempt any **four** from the **rest.**
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume **suitable** data whenever **required.**
(5) Vector notation **must** be used whenever **necessary.**

T-ELEC V Rev EMF & waves. 181509 MASTER

1. Attempt any **four** of the followings :— 20
   (a) Explain the equation of continuity and displacement current density.
   (b) A dipole moment $\overline{m} = 1{\cdot}6 \times 10^{-9}\,\hat{a}_z$ is located along z axis with z = 0, as it is bisecting the x-y plane. Determine potential V at A (3, 4, 8) m.
   (c) Explain method of images.
   (d) The region y < 0 contains dielectric material for which $\epsilon_{r_1} = 3$,
   while the region y > 0 having $\epsilon_{r_2} = 5$,
   When $\overline{E}_1 = 3\hat{i} - 4\hat{j} + 5\hat{k}$, then calculate $\overline{D}_2$ and θ_2.
   (e) Explain the concept of scalar and vector magnetic potential.

2. (a) State Gauss's law. Find the expression of E-field intensity $(\overline{E})$ due to a very long, straight uniformly charged wire by using Gauss's law. Find also the potential difference between any two points at a distance (a) and (b) from that charged wire. 10
   (b) It is required to hold four equal point charges + 40 μc each in equilibrium at the corner of a square. Find the point charge which will do this, if placed at the centre of the square. 10

3. (a) Find M-field induction $(\overline{B})$ at any point on the line passing through the center and perpendicular to the plane of a circular current loop. 10
   (b) Find the work done in moving a point charge 5 μc in the E-field. 10
   $$E = 4x\hat{a}_x - 3y\hat{a}_y \text{ V/m}$$
   (i) from (3, 0, 0) to (0, 0, 0) and from (0, 0, 0) to (0, 3, 0)
   (ii) from (3, 0, 0) to (0, 3, 0)
   along straight line path joining the two respective points comments on the result.

4. (a) Find potential variation, E-field intensity and capacitance for a concentric cable of length (l) of inner radius (a) and outer radius (b), when the outer sheath being insulated from the core by a dielectric medium. Inner core kept at the potential V_0 where as outer layer is grounded. 10
   (b) Given that $\overline{D} = 30e^{-r/b}\,\hat{a}_r - 2(z/b)\,\hat{a}_z\ c/m^2$ in cylindrical co-ordinate, find outward flux crossing the right circular cylinder described by r = 2b, z = 0 and z = 5 bm. 10

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5. (a) Derive the expression of E-field Intensity ($\overline{E}$) and potential (V) due to an Electric-Dipole. 10

(b) Consider a regular polygon of N-sides inscribed within a circle of radius R on X-Y plane which carry the current I. Now prove that the M field induction $\overline{B}$. 10

(i) at the center (0) of the circle is

$$\overline{B}_z = (N\mu I \tan\pi/N)/2\pi R\, \hat{a}_z$$

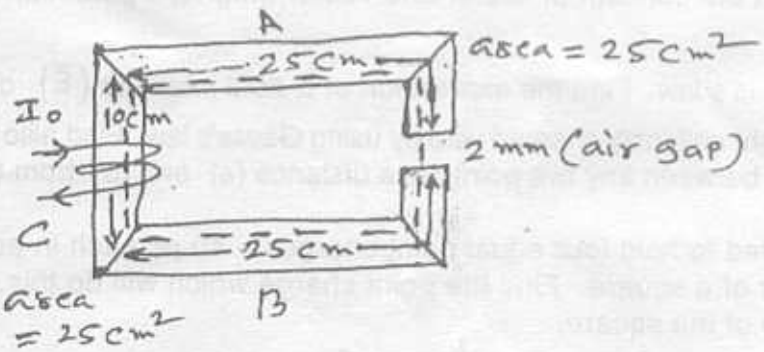
(ii) at the Point (P) at a Perpendicular distance (h) on the axis of the circle is

$$\overline{B}_z = (N\mu I \tan\pi/N \cos\beta)/2\pi d\, \hat{a}_z$$

where $d^2 = R^2 + h^2 \rightarrow$ the radial distance of the point (P) from the end points of the side of the polygon and β is the angle between R and d.

6. (a) What is poynting's vector ? Derive an expression for poynting's Theorem by explaining the physical significance of each terms. Write also the expression of average Complex Poynting's Vector. 10

(b) A magnetic circuit with an air gap is shown in the **figure**. How many turns on 10



the coil should be there to establish 1·0 wb/m^2 flux density in the air gap, when permeability of the steel core is 5×10^{-3} henry/m and maximum allowable current is 10 amp. Draw the analogous electrical circuit also.

7. (a) Starting with Maxwell's equations obtain vector wave equation for lossy dielectric solve it by considering $\overline{E}$ has only x-component at the wave is travelling in z-direction. Hence obtain expression of attenuation constant (α), phase constant (β), complex intrinsic impedance (η) and propagation constant (γ). 10

(b) (i) In free space $\overline{D} = D_m \sin(wt + \beta_z)\, \hat{a}_x$. 5

Now by using Maxwell's equation show that—

$$\beta = -\frac{w\mu_0 D_m}{\beta} \sin(wt + \beta_z)\, \hat{a}_y .$$

$$= -\eta_0 D_m \sin(wt + \beta_z)\, \hat{a}_y$$

(ii) In free space Cartesian co-ordinates, a potential function is given by 5

$$V = 2x^2 y - 5z.$$

Evaluate the potential at P(– 4, 3, 6) .

Also find $\overline{E}$ and $\overline{D}$ at this point.

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May 09 HP 39
Con. 2794-09.

VR-5062

(REVISED COURSE)

(3 Hours) [Total Marks 100

N.B. :— (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** out of remaining **six** questions.
(3) **All** questions carry **equal** marks.
(4) Assume suitable data if **necessary**.

1. (a) Explain the reasons for conducting Open Circuit Test in low voltage side and Short Circuit Test in high voltage side of a transformer. 20
(b) Draw torque–speed characteristics of DC shunt and series motor. What are the applications of shunt motor and series motor ?
(c) State and explain how armature current and speed of a dc separately excited motor will be affected by halving armature voltage with field current and load torque remaining constant. Neglect armature resistance.
(d) Explain the conditions required to be fulfilled for connecting two three phase transformers in parallel.

2. (a) A 500 KVA, transformer with 0·01 pu resistance and 0·05 pu reactance is connected in parallel with a 250 KVA transformer with 0·015 pu resistance and 0·04 pu reactance. The secondary voltage of each transformer is 400 V on no load. Find how they share a load of 750 KVA at power factor 0·8 lagging. 10
(b) Explain switching in phenomena of a transformer. 10

3. (a) Explain with neat phasor diagram the effect of harmonics in Y_y connection with out neutrals. 10
(b) Explain Back to back test in transformer. 20

4. (a) Starting from energy balance equation obtain expression for electromagnetic torque for doubly excited system in terms of angular rates of change of self and mutual inductance of stator and rotor winding. 10
(b) A 200 V shunt motor takes 10 A when running on no–load. At higher loads the brush drop is 2V and at light loads it is negligible. The stray load loss at a line current of 100 A is 50% of the no load loss. Calculate the efficiency at a line current of 100 A if armature and field resistances are 0·2 and 100Ω respectively. 10

5. (a) Explain with neat diagram, the armature reaction in DC machines. 10
(b) The Hopkinson's test on two machines gave the following results for full load. Line voltage 250 V ; line current encluding field current 150 A ; motor armature current 380 A ; field current 5 A and 4·2 A. Calculate the efficiency of each machine. Armature resistance of each machine = 0·02Ω. State the assumptions made. 10

6. (a) What are vector groups in transformer. Explain with neat circuit diagram and phasor diagram the following connection (i) yd – 1 (ii) yd – 11. 10
(b) Speed of a dc series motor coupled to a fan load is controlled by variation of armature voltage. When armature voltage is 400 V, motor takes 20 A and the fan speed is 250 rpm. The combined resistance of armature and field is 1·0Ω. Calculate motor armature voltage for the fan speed of 350 rpm. 10

7. Write short notes on any **two** :– 20
(a) Mechanical forces in transformer.
(b) Energy saving of copper in autotransformer.
(c) Interpole and compensating windings in D.C. machines.

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Con. 3326–09.

(OLD COURSE)

VR–4398

(3 Hours)

[Total Marks : 100

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** out of remaining.
(3) Assume data if **necessary**.

1. (a) With the help of neat diagram, explain Sumpner's test on transformer. 10
   (b) Explain power stages in three phase induction motor. 10

2. (a) Draw and explain torque speed characteristics of three phase induction motor. 10
   (b) Explain Capacitor start capacitor run single phase induction motor in detail. 10

3. (a) Explain logging and crawling phenomenon in three phase induction motor. 10
   (b) Explain star delta starter for induction motor. Compare its starting torque with starting torque of DOL. 10

4. (a) Explain phenomenon of oscillating neutral. 10
   (b) Two three phase transformers have following per phase parameters, reffered to secondary. 10

$re_1 = 0{\cdot}004\ \Omega \quad Xe_1 = 0{\cdot}018\ \Omega$

$re_2 = 0{\cdot}002\ \Omega \quad Xe_2 = 0{\cdot}012\ \Omega$

Transformer 1 is of 500 kVA and 2 is of 1000 kVA. These two transformers are connected for parallel operation. How will they share a load of 1500 kVA at 0·8pf logging ?

5. (a) Explain effects of harmonics ion transformer. 10
   (b) Explain excitation phenomenon in transformer. 10

6. (a) A three phase, star connnected, 400V, 50Hz 4 pole induction motor has the following per phase constants in Ω referred to stator. 10

$r_1 = 0{\cdot}15\ x_1 = 0{\cdot}45\ r_2 = 0{\cdot}12 \quad x_2 = 0{\cdot}45 \quad x_m = 28{\cdot}5$

Fixed losses (core and friction and windage losses) = 400W. Compute stator current, rotor speed, output torque and efficiency when motor is operated at rated voltage and frequency at a slip of 4%.
   (b) Explain mechanical forces developed in transformer. 10

7. (a) Explain speed control of three induction motor. 10
   (b) A 3 Phase squirrel cage induction motor has maximum torque equal to twice the full-load torque. 10
Determine the ratio of motor starting torque to its full load torque, if it is started by (i) DOL Starter (ii) Star-delta starter (iii) Auto transformer starter with 70% tappings.
The per phase rotor resistance and per phase standstill reactance referred to stator are 0·2Ω and 2 respectively. Neglect stator impedance.

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TE(E) Sem V (Rev) 01/06/09

Control System - I

Con. 3312-09. VR-5067

(REVISED COURSE)

(3 Hours) [Total Marks : 100

N.B.: (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions from the **rest**.
(3) **All** questions carry **equal** marks.
(4) Assume **suitable data** wherever **necessary**.
(5) **Numbers** to the **right** indicate **maximum** marks.

T.E(E) V Control System - I 1/6/09.

1. Solve any **four** :—

(a) Determine the transfer function for the system described by

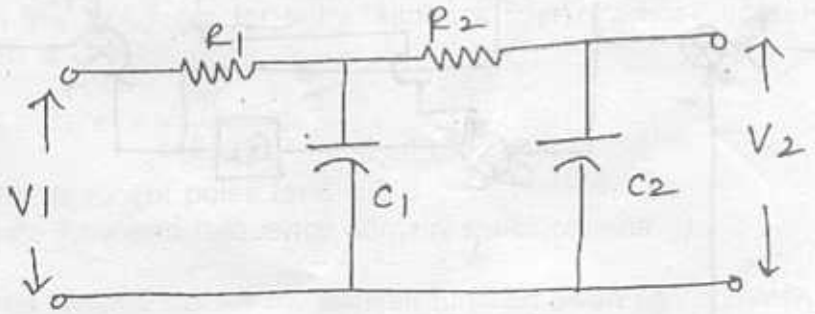
$$A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \quad C = [1\ 0], \quad D = 0.$$

(b) A unity feedback system has open loop transfer function $G(s) = \frac{10}{s(s+4)}$, determine its damping ratio and natural frequency.

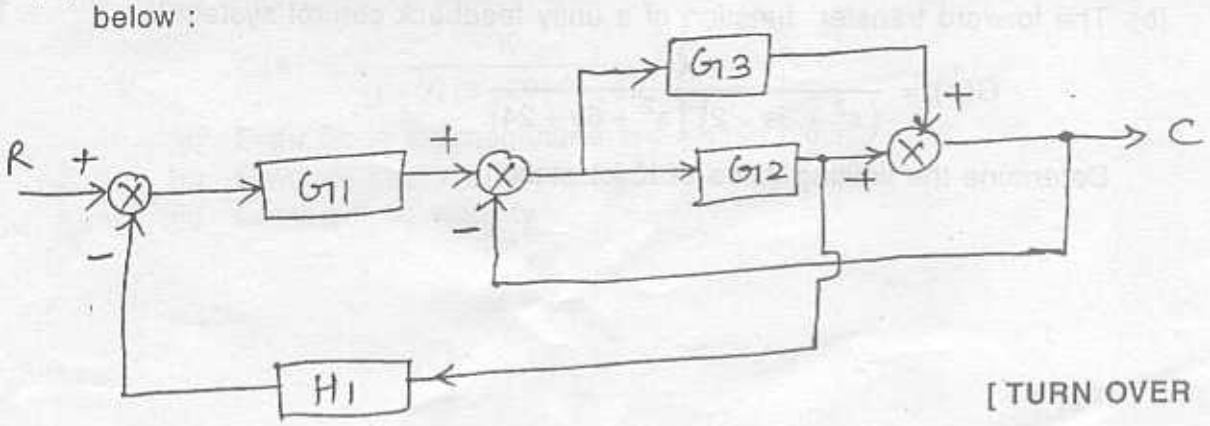
(c) Explain Nyquist stability criterion.

(d) A linear time invarient system initially at rest when subjected to a unit step input gives a response $y(t) = t \cdot e^{-t}$, $t > 0$. What is the transfer function of the system ?

(e) Find the transfer function by masons gain formula for following circuit.



2. (a) Determine the transfer function C/R from the block diagram shown in **figure** below : 10



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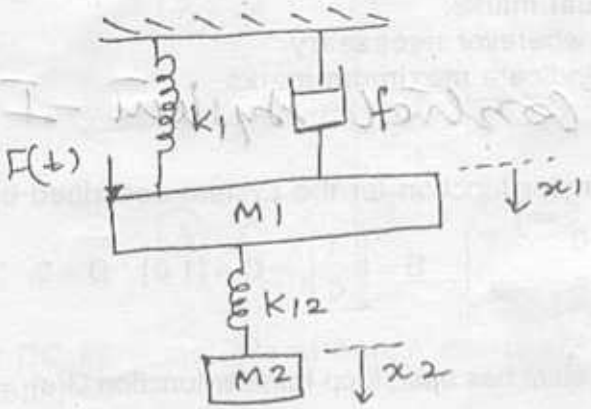
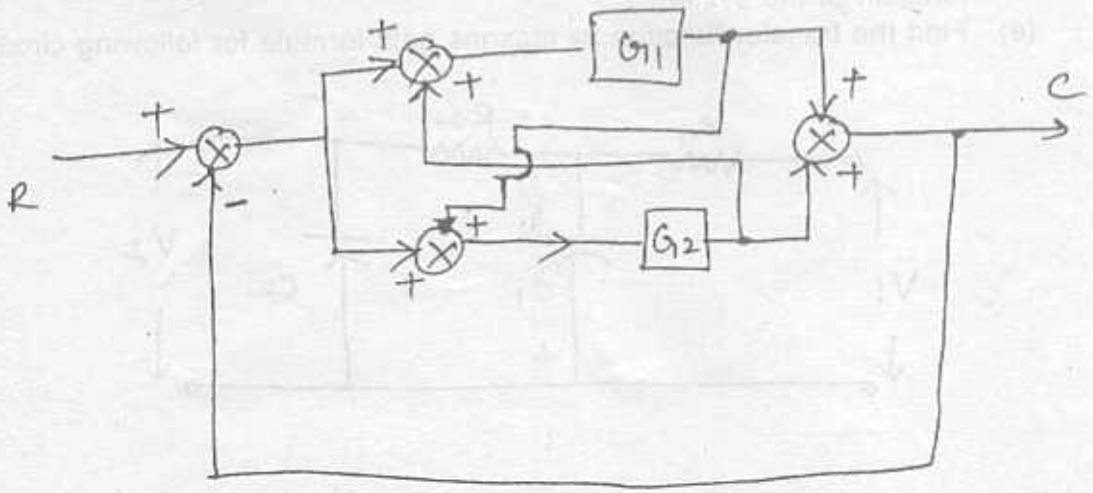
Con. 3312-VR-5067-09.

(b) Find the transfer function $G(s) = \frac{X_2(s)}{F(s)}$, for the translational mechanical system shown below : 10



3. (a) Determine the transfer function C/R for the following block diagram shown below using Mason's gain formula. 10



(b) The forward transfer function of a unity feedback control system is 10

$$G(s) = \frac{K}{(s^2 + 3s + 2)(s^2 + 6s + 24)}$$

Determine the limiting value of K for stability.

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T.E (E&C) IV Rev Control Systems I 11/6/08 Page (3)

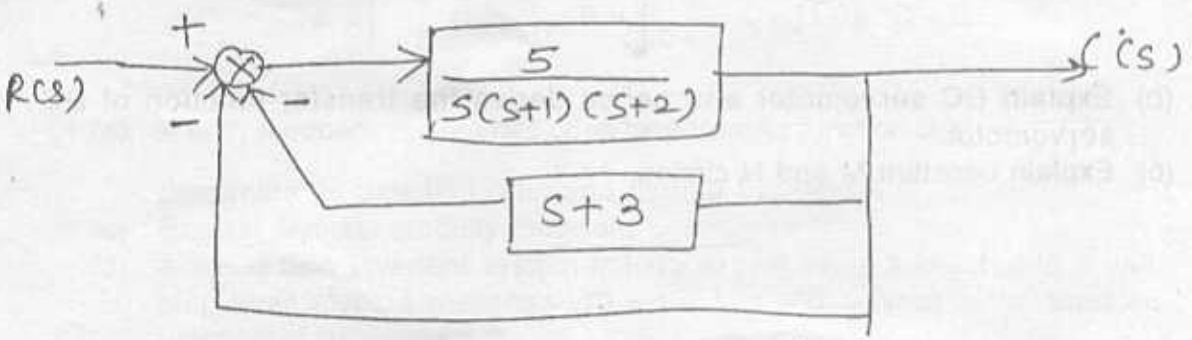
4. (a) The open loop transfer function of a unity feedback control system is given by 10

$$G(s) = \frac{25}{s(s+5)}$$

Calculate :

(i) Natural frequency of oscillations,
(ii) Damped frequency of oscillations,
(iii) Damping ratio,
(iv) Maximum overshoot and
(v) Steady state error for unit step input.

(b) For the system shown below find K_p, K_v and K_a. Also find steady state error for an input of 50tu(t). 10



5. (a) Sketch the root locus for unity feedback system whose open-loop transfer function is 10

$$G(s) = \frac{K}{s(s+11)}.$$

Find the dominent poles for $\xi = 0{\cdot}6$ 10

(b) Co-relate time and frequency domain specifications.

6. (a) Draw the Nyquist plot for the transfer function given and comment on stability. 10

$$G(s)\,H(s) = \frac{180}{(s+1)(s+2)(s+5)}.$$

(b) For a unity feedback system with 10

$$G(s) = \frac{K}{(s+5)(s+20)(s+50)}.$$

(i) Draw Bode log-magnitude and phase plots.
(ii) Evaluate gain margin and phase margin.
(iii) Comment on stability.

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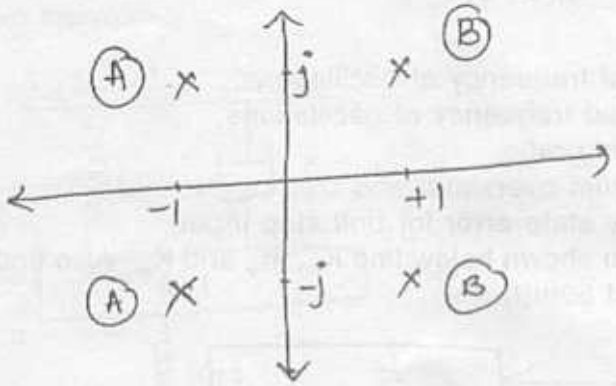
Con. 3312-VR-5067-09.

Page (4) T.E (E) V Rev Control System I 1/6/09

7. (a) Estimate the step response of the system having dominent poles at A, B. 5



(b) Explain DC servomotor and hence derive the transfer function of DC servomotor. 10

(c) Explain constant M and N circles. 5

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TE(E) Sem V Old 27/05/09

May 09 HP 103
Con. 3427-09.

Principles of Control Systems

VR-4402

(OLD COURSE)

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume suitable data, wherever **necessary**.
(4) **Figures** to the **right** indicate **full** marks.

T.E(E) V Old Principles of Control System

1. (a) Differentiate between open loop and closed loop control system. 4
(b) Explain how to find Kp, Kv and Ka from bode plot. 4
(c) The output of linear system for a unit step input is given by $t^2 e^{-t}$ find the transfer function of the system. 4
(d) Plot the bode plot for the following T.R. and comment on stability of the system. 4

$$GH(s) = \frac{1}{s+1} \text{ and } GH(s) = \frac{1}{s-1}.$$

(e) State with the help of diagram two special rules for B.D. reduction. i.e. interchanging summing and take off point.

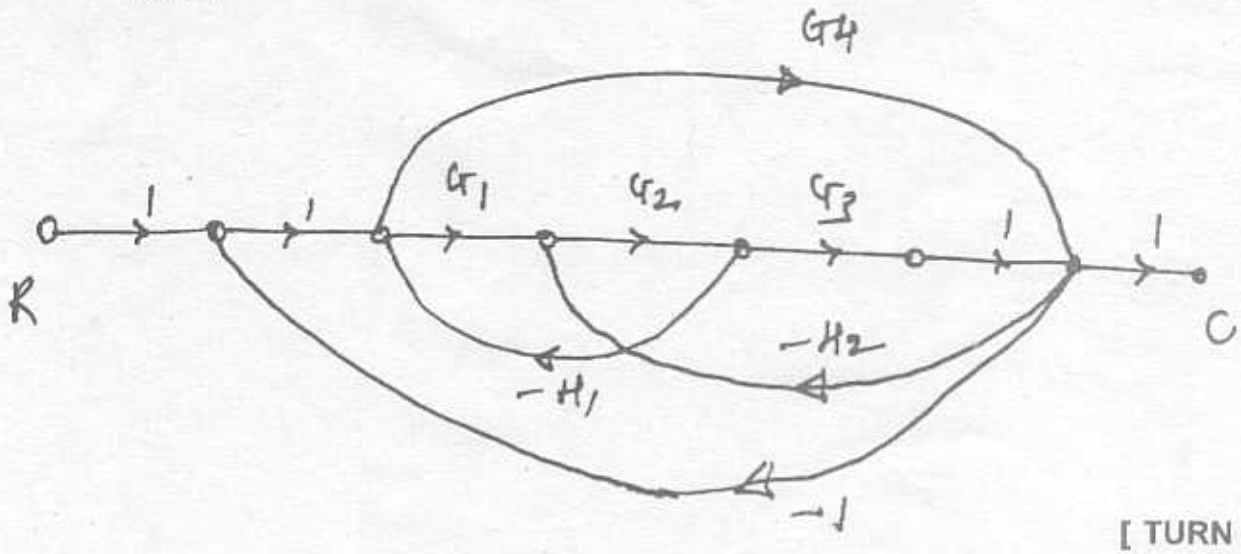
2. (a) Derive the formula for peak time T_p and peak overshoot M_p for standard second order system. 10
(b) Explain how Kp, Kv and ka can be determined from bode plot. 10

3. (a) For unity feedback system having– 10

$$G(s) = \frac{10\,(s+1)}{s^2\,(s+2)\,(s+10)}$$

Determine–
(i) Type of the system
(ii) Error coefficient and
(iii) Steady state error for input as $1 + 4t + t^2/2$.

(b) Using Mason's gain formula find the transfer function of signal flow graph shown below. 10



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4. (a) For a particular unity feedback system– 10

$$G(s) = \frac{242(s+5)}{s(s+1)\left(s^2+5s+121\right)}$$

Sketch the bode plot, find Wgc, Wpc, Gm and Pm and comment on stability.

(b) Explain in detail how to obtain– 10

(i) Break away point.

(ii) Intersection with imaginary axis in case of root locus.

5. (a) Explain the principle of argument in detail. 10

(b) Draw the Nyquist plot for system with $GH(s) = \frac{k}{s(s+1)(s+5)}$ and discuss stability. 10

6. (a) A feed back system has $GH(s) = \frac{100(s+4)}{s(s+0{\cdot}5)(s+10)}$. Draw the bode plot and comment on stability. 12

(b) For unity feed back system– 8

$$G(s) = \frac{k}{s(1+0{\cdot}4s)(1+0{\cdot}25s)}.$$

find the range of values of k-marginal and frequency of sustained oscillations.

7. Write short notes on :–

(a) Time domain specifications. 8

(b) Frequency domain specifications 8

(c) Steady state error and different error coefficient for different types of the systems. 4

TE (E) Sem V (old)
Instrumentation for Controls.

VT-April-09- 337

Con. 3446–09. (OLD COURSE) VR–6138

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any other **four** questions from remaining **six** questions.
(3) Assume suitable data if needed.

Page 1

T.E (E) Old Instrumentation for Controls

1. (a) Explain load cell and its working. 10
(b) State the sampling theorem. Explain working of a sample and hold circuits. 10

2. (a) Draw the three op-amp configuration of the Instrumentation Amplifier. Derive the expression for its output. 10
(b) Draw the functional block diagram of a general purpose C.R.O. Explain in brief the working of each block. 10

3. (a) Explain with neat diagram, the successive approximation type of analog to digital converter. 10
(b) Describe one of the digital to analog converter. 10

4. (a) List three types of temperature transducers and describe the application of each. 10
(b) Explain the working of Pirani guage. 10

5. (a) Explain the importance of vibration measurement. Give reasons for vibration measurement. 10
(b) Discuss the working of bourdon tube for pressure measurement. 10

6. (a) Discuss the various types of displays used in electronic instruments. 10
(b) Compare electronic and pneumatic controllers. 10

7. (a) Describe the constructional features of LVDT. Discuss factors affecting the bandwidth and sensitivity of LVDT. 10
(b) Clearly explain different types of strain gauges. Discuss various terms associated with such gauges. 10

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Signal Processing - I

Con. 2940-09. **VR-5070**

(REVISED COURSE)

(3 Hours) [**Total Marks : 100**

N.B.: (1) Question No. **1** is **compulsory.**
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assumptions made should be clearly **stated.**

T.E(Ex) V Rev Signal Processing I

1. Attempt any **four** of the following :— 20

(a) Sketch the signal :—

$$x(t) = 2u(t) - u(t-2) + u(t-4) - r(t-6) + r(t-8)$$

(b) Evaluate the following integral :—

(i) $\int_{1}^{2} (3t^2 + 1)\,\delta(t+3)\cdot dt$

(ii) $\int_{-2}^{4} (2 + t^2)\,\delta(t-1)\cdot dt + \int_{-1}^{1} t^2\,\delta(t+4)\,dt$

(c) Find the energy of the signal given by

$$X(n) = \left(\frac{1}{2}\right)^n u(n) + 3^n\, u(-n-1)$$

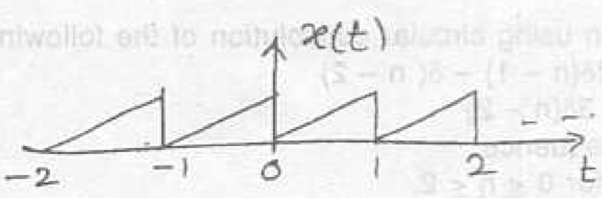
(d) State whether the following system is linear, stable, time variant, causal, memoryless or with memory :—

$$y(n) - y(n-1) + y(n-2) = 10x(n).$$

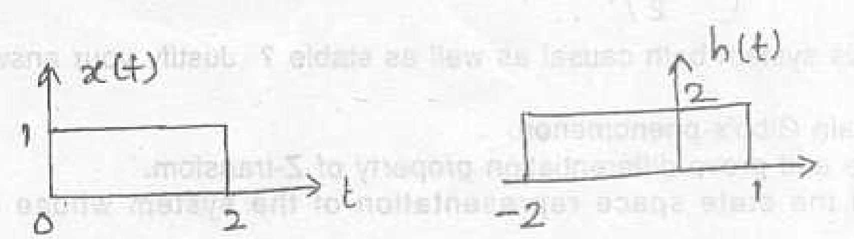
(e) Find the initial and final value of

$$X(s) = \frac{2s+3}{s^2+5s+1}$$

2. (a) Find exponential Fourier Series and plot Magnitude and phase spectrum for the sawtooth waveform shown below :— 10



(b) Find the response y(t) of an LTI system whose x(t) and h(t) are shown, using convolution integral method. 10



3. (a) If a DT-LTI system is BIBO stable, show that, the ROC of its system function H(z) must contain the unit circle i.e. | z | = 1. Also explain the condition for the LTI system to be both causal as well as stable. 8

(b) The output y(n) of a DT-LTI system is found to be $2\left(\frac{1}{3}\right)^n u(n)$ when the input x(n) is u(n). 12

(i) Find the impulse response h(n) of the system.

(ii) Find the output y(n) when the input x(n) is $\left(\frac{1}{2}\right)^n u(n)$.

4. (a) Find the Fourier Transform of the functions :— 8

(i) $x_1(t) = u(t)$ (ii) $x_2(t) = \text{sgn}(t)$

(b) Find Inverse Laplace transform of :— 12

$$X(s) = \frac{-3}{s^2+s-2}$$ if the ROC is

(i) $-2 < \text{Re}(s) < 1$

(ii) $\text{Re}(s) > 1$

(iii) $\text{Re}(s) < -2$

5. (a) An LTI system is described by the equation— 12

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = \frac{dx(t)}{dt} + 4x(t)$$

The input $x(t) = e^{-1}\,u(t)$.

Find the total response of the system for the initial conditions

$y(0^+) = 3$, $\frac{dy(0^+)}{dt} = 0$.

(b) Find Z-transform of the following :— 8

(i) $x(n) = [\,3(3)^n - 4(2)^n\,]\,u(n)$

(ii) $x(n) = \left(\frac{1}{3}\right)^{n-1} u(n-1)$

6. (a) Obtain linear convolution using circular convolution of the following :— 8

$x(n) = \delta(n) + 2\delta(n-1) - \delta(n-2)$

and $h(n) = 2\delta(n) + 3\delta(n-2)$

(b) Find 4-point DFT of a sequence 8

$x(n) = 1$ for $0 \le n \le 2$.

$= 0$ otherwise.

Plot $|X(k)|$ and $\angle X(k)$.

(c) A DT-LTI system is characterized by the transfer function 4

$$H(z) = \frac{z(3z-4)}{\left(z-\frac{1}{2}\right)(z-3)}$$

Is this system both causal as well as stable ? Justify your answer.

7. (a) Explain Gibb's phenomenon. 5

(b) State and prove differentiation property of Z-transfom. 5

(c) Find the state space representation of the system whose difference 10

equation is $\frac{d^3y(t)}{dt^3} + 3\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t)$

$$= \frac{d^2x(t)}{dt^2} + 6\frac{dx(t)}{dt} + 5x(t)$$

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TE (E) V (Rev)

Elements of Power sys

Con. 2845-09. VR-5064

(REVISED COURSE)

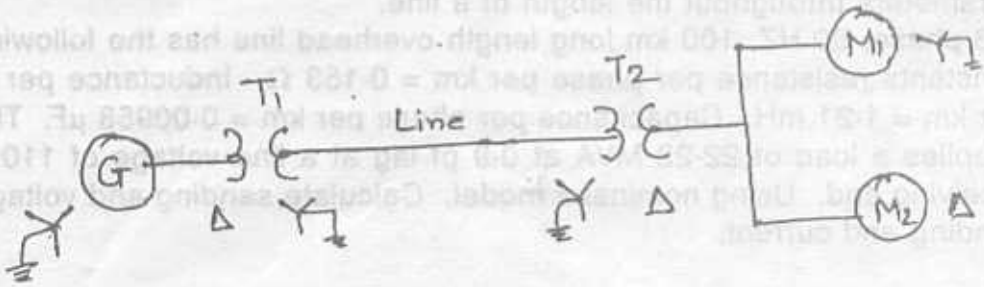
(3 Hours) [Total Marks : 100

N.B.:(1) Question No. 1 is **compulsory.**
(2) Attempt any **four** questions out of **remaining** questions.
(3) Assume data if **necessary.**

T.E (E) V Rev Elements of Power Sys.

1. (a) Derive an expression for capacitance of a three phase line with unsymmetrical spacing.
(b) Explain different methods to improve string efficiency. 10

2. (a) Following **figure** shows a generator feeding two motors through transformers and a line. The ratings are as follows : 15
Generator : 100 MVA, 11 KV, 3 Phase, X = 20%
Transformer 1 : 3 phase, 100 MVA, 11/132 KV, X = 5%.
Transformer 2 : Bank of three single phase transformers each rated at 35 MVA, 66/11 KV, X = 4%.
Motor M1 : 40 MVA, 3 phase, 10 KV, X = 20%
Motor M2 : 60 MVA, 3 phase, 11 KV, X = 15%
Line reactance is 80 Ω
Selecting a base MVA of 100 and 11 KV base in generator section, find new p.u. reactances and draw p.u. dig.



(b) P.U. impedance of a transformer referred to both windings can be made same by selecting proper voltage base on both sides. Prove it. 5

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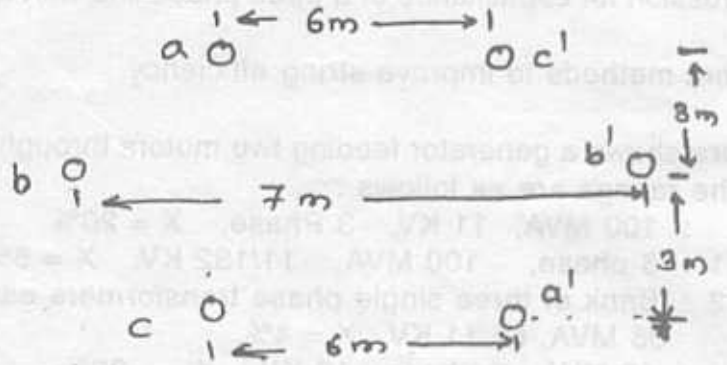
Con. 2845-VR-5064-09.

3. (a) Derive an expression for inductance of a single phase line having COMPOSITE CONDUCTORS. Hence explain GMD and GMR. 10

(b) A three phase double circuit line has a configuration as shown in **figure.** The radius of each conductor is 0·9 cm. Find inductance per phase per km of line length. 10



4. (a) Find ABCD constants of a long length transmission line with distributed parameters throughout the length of a line. 10

(b) A 3 phase, 50 HZ, 100 km long length overhead line has the following line constants resistance per phase per km = 0·153 Ω. Inductance per phase per km = 1·21 mH. Capacitance per phase per km = 0·00958 μF. The line supplies a load of 22·22 MVA at 0·9 pf lag at a line voltage of 110 KV at receiving end. Using nominal π model. Calculate sending and voltage and sending end current. 10

5. (a) Explain current rating of the cable. 10

(b) Explain measurement of earth resistance and soil resistivity. 10

6. (a) Explain non-conventional energy sources. 10

(b) Explain the features of isolated neutral system and effectively earthed system. 10

7. Write short notes on : 20

(a) Ferranti effect

(b) Tuned power line

(c) Skin effect and proximity effect.

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Cont 3616–09. (REVISED COURSE) VR–5073

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory.**

(2) Answer any **four** questions out of remaining **six** questions.

1. (a) Find the distribution function for the sum of the numbers appearing on the toss of two unbiased dice. 5

(b) Using the pigeonhole principle show that if any 11 numbers are chosen from the set {1, 2, 3, ... 20} then one of them will be a multiple of another. 5

(c) Let S be a non-empty set and let R be a relation on S. Suppose the following properties hold (i) For every $x \in S$, xRx (ii) For every $x, y, Z \in S$, xRy, yRz implies zRx. Prove that R is an equivalence relation. 5

(d) The marks obtained by a number of students in a certain subject are approximately normally distributed with mean 65 and standard deviation 5. If 3 students are selected at random from this group, what is the probability that at least 1 of them would have scored above 75 ? 5

2. (a) A population consists of five numbers 2, 3, 6, 8 and 11. Consider all possible samples of size Two that can be drawn with replacement from this population. Find the mean and variance of – 12

(i) the population

(ii) the sampling distribution of means.

Verify (ii) directly from (i) by use of suitable formulas.

(b) The following data is collected on Two characters. Based on this, can you say that there is no relation between Smoking and Literacy ? 8

	Smokers	Non-Smokers
Literates	83	57
Illiterates	45	68

3. (a) An analyst for a certain company was studying the relationship between travel expenses in rupees (Y) for 102 sales Trips and the duration in days (X) of these trips. He has found that relationship between Y on X is Linear. A summary of the data is given below : 8

$\Sigma X = 510$; $\Sigma Y = 7,140$; $\Sigma X^2 = 4,150$; $\Sigma XY = 54,900$ and $\Sigma Y^2 = 7,40,200$

(i) Estimate the two regression equations from the above data.

(ii) A given trip has to take seven days. How much money should a salesman be allowed so that he will not run short of money ?

(b) The p.d.f. of a random variable X is $f(x) = kx\, e^{-x/3}$ $x > 0$ 6

$= 0$ $x < 0$

Find k_1 mean, variance and m.g.f about origin for the distribution.

(c) Given the posets (D4, $\leq$) and (D9, $\leq$) under the usual notation draw the Hasse diagram for $L = D_4 \times D_9$ under the product partial order. 6

4. (a) Two random variables X and Y are jointly normally distributed U and V are defined as $U = X \cos \alpha + Y \sin \alpha$ 8

$V = Y \cos \alpha + X \sin \alpha$

Show that U and V will be uncorrelated if

$$\tan \alpha = \frac{2r\sigma_x \sigma_y}{\sigma_x^2 - \sigma_y^2}$$

(b) An ambulence service claims that it takes on an average 8·9 min to reach the destination in emergency calls. To check this the Licensing Agency has them timed on 50 emergency calls, getting a mean of 93 min with a s.d 1·6 min. Is the claim acceptable at 5% LOS ? 6

(c) Fit a second degree parabola to the following data and estimate Y if X = 6. 6

X	1	2	3	4	5
Y	25	28	33	39	46

5. (a) Samples of two types of electric bulbs were tested for length of life and the following data were obtained. 8

	Size	Mean	SD
Sample 1	8	1234h	36h
Sample 2	7	1036h	40h

Is the difference in the means sufficient to warrant that type 1 bulbs are superior to type 2 bulbs ?

(b) Functions f and g are defined as follows :— 6

$f : R \to R, \quad g : R \to R, \quad f(x) = 2x + 3, \quad g(x) = 3x - 4$

Find fog, f^{-1}, g^{-1} and verify that $(fog)^{-1} = g^{-1} o\, f^{-1}$

(c) 'G' is a set of all square matrices of type $\begin{bmatrix} 1 & m \\ 0 & 1 \end{bmatrix}$ where $m \in Z$, prove that 'G' is a group under multiplication. Is it an abelian group ? 6

6. (a) The following data represent the marks obtained by 12 students in 2 tests. One held before coaching and the other after coaching. 8

Test 1	55	60	65	75	49	25	18	30	35	54	61	72
Test 2	63	70	70	81	54	29	21	28	32	50	70	80

Does the data indicate that the coaching was effective in improving the performance of the students.

(b) In a precision bombing attack there is a 50% chance that any one bomb will strike the target. Two direct hits are required to destroy the target completely. How many bombs must be dropped to give at least 99% chance of destroying the target ? 6

(c) Let $A = \{ 1, 2, 3, 4 \}$ and $\leq$ be the relation 'is less than'. 6

$A' = \{ 3, 6, 9, 12 \}$ and $\leq$ be the relation 'is less than'.

If $f : A \to A'$ is given by $f(a) = 3a$, Are the lattices isomorphic ? Draw Hasse Diagram.

7. (a) Obtain the rank correlation coefficient from the following data :— 8

x	10	12	18	18	15	40
y	12	18	25	25	50	25

(b) Let $A = \{ 2, 3, 6, 12, 24, 36 \}$ and R be the Relation 'is divisible by' i.e. aRb means a/b. Obtain the relation matrix and draw Hasse diagram. 6

(c) Prove that Z_4 is a ring under addition and multiplication modulo 4. 6

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TE(E) sem V (OLD)

May 09 HP 161
Con. 3452-09.

Applied Math's-V

VR-6142

(OLD COURSE)

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Use of statistical tables **permitted**.
(4) **Figures** to the **right** indicates **full** marks.

TE(E) V Old Appl. Maths V 10/6/09

1. (a) Prove that $-1 \leq r \leq 1$ where r is Karl Pearson's coefficient of correlation. 5
(b) A fair dice is thrown thrice. Find the probability that the sum of the numbers obtained 10. 5
(c) Find the probability that at most 4 defective bulbs will be found in a box of 200 bulbs if it is known that 2% of the bulbs are defective. 5
(d) Let A = Z and R = $\{ (a, b) \in A \times A \mid a \equiv b \pmod m \}$ 5
Prove that R is an equivalence relation.

2. (a) Find the mean and variance of Poisson distribution. Hence find the mean and variance of P(x = 1) = 2 P(x = 2). 8
(b) Is the following function (i) Injective (ii) Surjective $f : R \to R$, $f(x) = 2x^2 + 5x - 3$. 6
(c) Fit a second degree parabolic curve to the following data– 6

X	1	2	3	4	5	6	7	8	9
Y	2	6	7	8	10	11	11	10	9

3. (a) Show that the set $F = \{ a + b\sqrt{2} \}$ where a and b are rational numbers is a field under addition and multiplication. 8
(b) A continuous random variable X has the p.d.f. $f(x) = kx^2 e^{-x}$, $x \geq 0$. Find k, mean and variance. 6
(c) Two random variable x and y are jointly normally distributed and u and v are defined by $u = x \cos \alpha + y \sin \alpha$, $v = y \cos \alpha - x \sin \alpha$. Show that u and v will be uncorrelated if $\tan 2\alpha = \frac{2r\sigma_x \sigma_y}{\sigma_x^2 - \sigma_y^2}$. 6

4. (a) If f and g are defined as $f : R \to R$, $f(x) = 2x - 3$, $g : R \to R$, $g(x) = 4 - 3x$ then– 8
(i) Verify that $(fog)^{-1} = g^{-1} of^{-1}$
(ii) Solve fog(x) = gof(1).
(b) The marks obtained by students in a certain examination follow a normal distribution with mean 45 and standard deviation 10. If 1000 students appeared at an examination, calculate the number of students scoring – 6
(i) less than 40 marks
(ii) more than 60 marks.
(c) Obtain the rank correlation coefficient from the following :– 6

X	10	12	18	18	15	40
Y	12	18	25	25	50	25

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5. (a) Seven coins are tossed and the number of heads obtained is noted. The experiment is repeated 128 times and the following distribution is obtained – 8

No. of heads	0	1	2	3	4	5	6	7	Total
Frequency	7	6	19	35	30	23	7	1	128

Fit a Binomial distribution if–
(i) the coins are unbiased
(ii) if the nature of coins is not known.

(b) Let A be a set of integer and R be a relation on A × A defined by (a, b) R (c, d) if $a + d = b + c$. Prove that R is an equivalence relation. 6

(c) A panel of two judges A and B graded dramatic performance by independently awarding marks as follows : 6

Performance No.	1	2	3	4	5	6	7
Marks by A	36	32	34	31	31	32	35
Marks by B	35	33	31	30	34	32	36

The eight performance, however which judge B could not attend, got 38 marks by judge A.

6. (a) (i) If n is a +ve integer and p^2/n (p^2 divides n) then D_n (the set of all +ve divisions of n) is not Boolean algebra. 4

(ii) For all $x \in B$ (Boolean algebra) the complement of the complement of x if exist is x i.e. $\bar{\bar{x}} = x$ if $\bar{x}$ exist. 4

(b) Determine whether the set A of all ordered pairs (a, b) of real number ($a \neq 0$) under * defined by $(a, b) \forall (c, d) = (ac, bc + d)$ is an Abelian group. 6

(c) Using Mathematical induction prove that the product of three consecutive integers is divisible by 6 and that $n^4 - 4n^2$ is divisible by 3 for all $n \geq 2$. 6

7. (a) Six guinea pigs injected with 0·5 mg of a medication took an average 15·4 secs to fall asleep with an unbiased standard deviation 2·2 secs, while 6 other guinea pigs injected with 1·5 mg of medication took on an average 11·2 secs to fall asleep with an unbiased standard deviation 2·6 cms. Use 5% level of significance to test the null hypothesis that the difference in dosage has no effect. 8

(b) Find the truth tables for– 6

(i) $(p \rightarrow q) \rightarrow r \langle = \rangle p \rightarrow (q \rightarrow r)$

(ii) $(\sim p \vee q) \rightarrow (p \wedge \sim q)$

(c) A hospital switch board receives an average of 4 emergency calls in a 10 minutes interval. What is the probability that– 6

(i) there are at least 2 emergency calls.

(ii) There are exactly 3 emergency calls in an interval of 10 minutes.

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